CLAIMS

1. A method of making an anode for an electrochemical cell, said method comprises the steps of:

(a) depositing onto a substrate a first anode active layer comprising lithium metal, or providing a lithium metal foil as a first anode active layer;

(b) depositing over the first anode active layer a first layer comprising a polymer or a single ion conducting layer;

(c) depositing over the first layer of step (b) a second layer comprising a single ion conducting layer if the layer of step (b) is a polymer, or a polymer layer if the layer of step (b) is a single ion conducting layer; and

(d) depositing over the second layer of step (c) a third layer comprising a single ion conducting layer if the layer of step (c) is a polymer, or a polymer layer if the layer of step (c) is a single ion conducting layer, to form said anode comprising:

(i) said first anode active layer comprising lithium metal; and

(ii) a multi-layer structure in contact with a surface layer of said first anode active layer, wherein said multi-layer structure comprises three or more layers, wherein each of said three or more layers comprises a layer selected from the group consisting of single ion conducting layers and polymer layers.

2. The method of claim 1, wherein subsequent to step (d), step (d) is repeated one or more time to form said multi-layer structure comprising four or more layers.

3. The method of claim 1, wherein the thickness of said first anode active layer is 2 to 100 microns.

4. The method of claim 1, wherein the thickness of said multi-layer structure is 0.5 to 10 microns.

5. The method of claim 1, wherein the thickness of said multi-layer structure is 1 to 5 microns.

6. The method of claim 1, wherein subsequent to step (b), there is a further step of depositing a metal alloy layer, wherein said metal alloy comprises a metal selected from the group consisting of Zn, Mg, Sn, and Al, wherein said metal layer is interposed between said polymer and said single-ion conducting layers.

7. The method of claim 1, wherein said single ion conducting layer of said multi-layer structure comprises a glass selected from the group consisting of lithium silicates, lithium borates, lithium aluminates, lithium phosphates, lithium phosphorus oxynitrides, lithium silicosulfides, lithium germanosulfides, lithium lanthanum oxides, lithium tantalum oxides, lithium niobium oxides, lithium titanium oxides, lithium borosulfides, lithium aluminosulfides, and lithium phosphosulfides, and combinations thereof.

8. The method of claim 1, wherein said polymer layers comprise a cross-linked polymer.

9. The method of claim 1, wherein said polymer layer of said multi-layer structure comprises a polymer layer formed from the polymerization of one or more acrylate monomers selected from the group consisting of alkyl acrylates, glycol acrylates, and polyglycol acrylates.

10. The method cell of claim 1, wherein after step (a) and prior to step (b), there is a step of depositing a temporary protective metal layer on a surface of said anode active layer.

11. The method cell of claim 1, wherein after step (a) and prior to step (b), there is a step of treating said first anode active layer with a gaseous material to form an intermediate layer, wherein said intermediate layer is interposed between said first anode active layer and said multi-layered structure.

12. The method cell of claim 1, wherein after step (a) and prior to step (b), there is a step of treating said first anode active layer with a plasma CO_2 treatment to form an intermediate layer, wherein said intermediate layer is interposed between said first anode active layer and said multi-layered structure.

13. The method cell of claim 1, wherein in step (a) said lithium is co-deposited in-situ with one or more gaseous materials onto said substrate.

14. The method of claim 13, wherein said gaseous material is CO_2.

15. The method of claim 1, wherein said substrate of step (a) is selected from the group consisting of metal foils, polymer films, metallized polymer films, electrically conductive polymer films, polymer films having an electrically conductive coating, electrically conductive polymer films having an electrically conductive metal coating, and polymer films having conductive particles dispersed therein.

16. An anode of an electrochemical cell, wherein said anode comprises:

(a) an anode active layer comprising lithium metal co-deposited in-situ with one or more gaseous materials; and

(b) a substrate.

17. The anode of claim 16, wherein said one or more gaseous materials are selected from the group consisting of carbon dioxide, acetylene, nitrogen, ethylene, sulfur dioxide, and hydrocarbons.

18. The anode of claim 16, wherein said gaseous material is carbon dioxide.

19. The anode of claim 16, wherein said substrate of step (b) is selected from the group consisting of metal foils, polymer films, metallized polymer films, electrically conductive polymer films, polymer films having an electrically conductive coating, electrically conductive polymer films having an electrically conductive metal coating, and polymer films having conductive particles dispersed therein.

20. The anode of claim 16, wherein said anode further comprises a multi-layered structure in contact with a surface of the anode active layer, on the side opposite to the substrate.